Eoclima

EARTH OBSERVATION FOR CLIMATE ACTION

gmv

INNOVATING SOLUTIONS

Eoclima for cities and urban areas

We present ***Eoclima,*** GMV solution to support climate action through climate-related geo-information products, derived from satellite-based Earth Observation data. We will show how ***Eoclima*** contributes to **addressing cities and urban areas risk assessment challenges**, and supports climate risk management and adaptation.

eoclima@gmv.com
gmv.com

CHALLENGES

By 2019, **56% of the world's population lived in urban areas.** The proportion is expected to increase to 68% by 2050 with nearly 90% of the growth in Asia and Africa. The large-scale, global impacts induced by **climate change** cause cities to face multiple future challenges. Urban development increases flood risk due to local changes in hydrological and hydrometeorological conditions that increase flood hazard, as well as incrementing vulnerability and exposure due to the population concentration. Extreme heat in cities is a serious problem that is exacerbated with the globa warming. The urban heat island (UHI) effect can result in an additional 2–5°C increase in temperature above those of surrounding rural areas.

Responding to challenges in urban areas is made all the more difficult for fast-growing communities, especially those in developing countries, due to a lack of long-term reliable data at resolutions that are appropriate for city-level planning and geospatial risk assessment.

SOLUTION

Adapting to flooding and urban heat island effects induced by urbanization and climate change is key to minimize impacts on urban population and infrastrutures. **Earth Observation** (EO) provides city managers the possibility to identify population that are vulnerable to natural hazards, to assess susceptible infrastructures, and to define feasible measures to assess a city's risk.

GMV has worked on several projects to integrate EO services into the decision making and design processes to help solve a range of problems for urban areas. As more and more climate finance becomes increasingly aware of the strengths and benefits of EO data, they are being used for an even greater range of problem-solving to help build climate resilience in many different contexts.

Eoclima is GMV's catalogue of climate-related geo-information products to facilitate the management of environmental resources by organizations involved in the process: NGOs, multilateral climate finance initiatives, International Financial Institutions (IFIs), and environmental and conservation agencies as well as national and local Governments.

Eoclima meets all currently existing geospatial data standards so, our geospatial products can be downloaded into and/or consumed by any geo-viewer through Open Geospatial Consortium (OGC) standard services.

Eoclima SUPPORT FOR CLIMATE POLICY

Eoclima products support the climate resilient pathways through the societal transformational process to achieve long-term emissions reductions and sustainable resilient development. This support is decoupled into main broad applications that lead to climate services tailored into products, here presented, and EO-derived parameters.

Application	Service	Product	Parameter

Climate risk management and adaptation	Climate risk assessment and monitoring	Climate adaptation and mitigation synergies
- Water resources management - Coastal risk management - Ecosystem sustainability - Forest condition assessment - Agriculture and food security - Livestock - **Cities and urban areas**	- Floods - Landslides - Soil erosion - Water scarcity - Wildfire - Extreme temperatures - Compound risks	- REDD+ / LULUCF - Sustainable forestry

Eoclima service for cities and urban areas provides the following **products**:

The **Urban flooding** product provides the damage grading and delineation of the flood extent affecting an urban area. Flood mapping integrates satellite radar and optical imagery, and grading employs additional socio-economic data.

The **Urban heat island** product evidences the UHI effect by measuring land surface temperatures from thermal observations of satellite, and deriving air temperatures at the city by using meteorological and ancillary data resources. Knowing which urban areas are most effected by heat is important when planning urban development to minimise the UHI effect and to adapt for higher temperatures from climate change.

This product also supports development and monitoring of nature-based solutions to climate-induced urban risks, such as mapping of the urban green infrastructure cover at city level to analyse impacts of the green areas and the build-up land on the urban heat island for better urban planning and management.

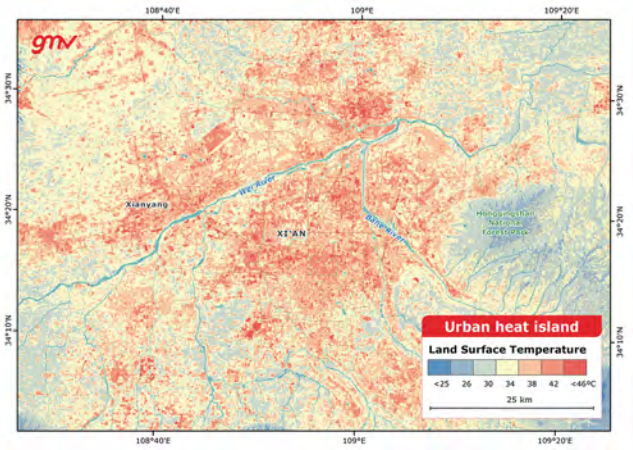
USE CASE: DEALING WITH EXTREME HEAT AND THE URBAN HEAT ISLAND EFFECT IN XI'AN (PEOPLE'S REPUBLIC OF CHINA)

Xi'an is the most densely populated city and capital of Shaanxi Province in Central China, one of the centres of ancient Chinese civilization. In the 90's, similar to the rapid economic growth that occured in the majority of cities across the People's Republic of China (PRC), the city of Xi'an went through **rapid urbanisation** to meet the needs of economic development and infrastructures redesign. The significant demand for housing was achieved with inadequate urban planning and a lack of long-term plan to urban socio-economic and environmental factors. The rapid urbanization led, for instance, to urban expansion into high-risk flood areas. As Xi'an lies on an extensive flood plain, the city is subject to occasional flooding during the East Asian monsoon season. Potentially damaging and life-threatening fluvial and pluvial flooding are expected to increase in the future due to the effects of climate change.

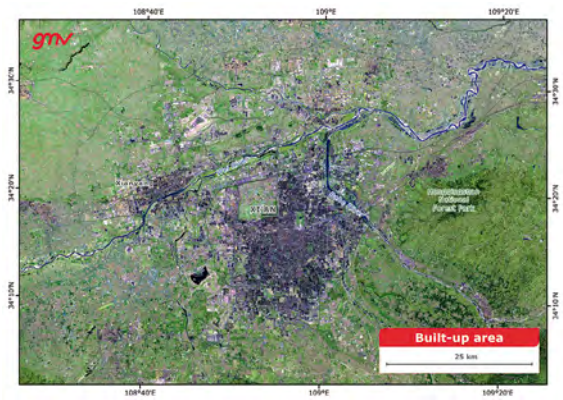
Xi'an is also vulnerable to extreme heat hazard, that is, the prolonged exposure to extreme heat that results in heat stress. Extreme heat conditions are particularly worrying for urban environments due to the well-known phenomenon **urban heat island (UHI)**, in which the temperature in urban areas is significantly higher than nearby rural area. The number of individuals in cities exposed to extreme temperatures is increased by the UHI-induced warming. UHIs can lead to multiple consequences, such as increased air pollution, morbidity, and energy consumption, and thus, have an adverse impact on residents' lives in cities.

Xi'an current planning of land use and infrastructure operation and maintenance do not adequately incorporate the impacts projected by climate change, including the impact of increased temperatures. As for many cities, extreme heat is a serious problem that will become worse due to global warming, and the consequences of the UHI effect will be even aggravated by the increasing urbanization. The Asian Development Bank (ADB) supports the climate resilient activities in PRC, and is currently assessing climate risks and preparing international and domestic good practice cases on urban climate change adaptation. Xi'an was selected by ADB for the development of a good practice guide on urban adaptation to face the expected climate change impacts.

GMV developed time-series of land surface temperature (LST) maps of Xi'an to analyse the surface **urban heat island** (SUHI) effect and infer the impact of the global warming and urban development over the satellite-record period. The SUHI reports the difference in land surface temperatures in cities and nearby rural areas observed by satellite-based thermal sensors. Due to their consistent data streams, large-scale observations of Earth's surface, satellites provide an optimal estimation and urban thermal environment characterization. The cities and urban service example shows a map of **land surface temperatures** at 100m derived from the satellite Landsat-8 for the urban areas of Xi'an in August 2019 and a map of **built-up areas** derived from Sentinel-2 for the same region to support climate resilience activities of ADB.



In an urban adaptation assessment plan, EO data can help to understand and model thermal activity and ventilation in and around cities and inform planning and 'climate-adaptive' building design, to deal with heatwaves. EO data can also be further analysed to detect actual urban heat islands by transforming the land surface temperatures observed to derive air temperatures with the support of meteorological modelling.



The **vegetable strata** product provides spatial data to analyse the effects of the UHIs on the build-up area. The sample product overview shows the Sentinel-2 derived vegetation index for Xi'an for August 2019. Urban vegetation regulates urban temperatures mainly by shading, CO2 sequestration and evapotranspiration, and is key in the adaptation to UHI effects. Therefore, increasing urban vegetation is the main option explored by ADB to mitigate UHI.

Remote Sensing
&
Geospatial Analytics

For more information on the products under this service and the parameters included contact us on eoclima@gmv.com!

A product by:

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